Between California and the Pacific Northwest

Between California and the Pacific Northwest: The Front Lax Vowels in San Francisco English[1]

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Abstract
The present analysis builds on previous evidence for the California Vowel Shift in San Francisco English (Hall-Lew 2009, 2013) with data on the lowering and retraction of BET (Kennedy & Grama 2012) and the BAT nasal split (Eckert 2008). Based on interview speech from a socially stratified sample of 22 San Franciscans, women lead men in the retraction changes, and European Americans lead Chinese Americans in both BAT retraction and BAN raising. We also find the first evidence for gender-differentiated change in BAN raising when the nasal is velar. Furthermore, preliminary data suggest a pre-velar effect for BET and BAT, which is best described as inhibition of retraction and lowering, not the raising movement of Pacific Northwest varieties (Becker et al. current volume, Wassink current volume). Overall, San Francisco English exhibits precisely the Northern Californian vowel system expected, rather than being an exceptional dialect island (cf. Labov et al. 2006).

1 Introduction

English in the Western United States has been described as largely homogenous, primarily based on the BOT/BOUGHT merger and its contrast with the Northern Cities and the South (Labov 1991). However, as the current volume demonstrates, differentiation within Western US English can be found, based on certain distinct features. One example is San Francisco English, where a delayed acquisition of the low back merger has led to San Francisco English being identified as distinct from other Western varieties (Labov et al. 2006). The current investigation focuses on the presence or absence of two other Western US English features in San Francisco: the front lax vowels in the California Shift (Kennedy & Grama 2012), and pre-velar raising of BET and BAT characteristic of the Pacific Northwest English (Wassink current volume). Previous work has shown San Franciscans to participate in other features that characterize the California Shift, such as the fronting of BOOT and BOAT (Hall-Lew 2009, 2011), as well as the low back vowel merger (Moonwomon 1991; Hall-Lew 2013). However, these back vowel features do little to speak to the distinctiveness of California English vis-à-vis the rest of the Western US, because all three changes have also been found in other Western states (e.g., Hall-Lew 2005;

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Labov et al. 2006). While the front vowel shift is potentially more distinctive to California, evidence of its occurrence in San Francisco is still preliminary (Hall-Lew et al. to appear). Furthermore, while pre-velar raising has been shown to occur as far south as Oregon (Becker et al. current volume), there has been no investigation as to whether this feature might be found in San Francisco; perhaps it could be a feature distinguishing Northern and Southern California Englishes? In short, the lack of evidence on the features that are associated with San Francisco English and its relationship to other varieties in the Western US demonstrates the need for further study of this variety, which the present paper undertakes.

1.1 The California Shift

The California Shift involves a lowering and retraction of BIT and BET, a fronting of BOOT and BOAT, a merger of BOT and BOUGHT, a fronting of BUT, and 'a nasal split' whereby BAN (BAT before nasals) raises and fronts and BAT before non-nasals lowers and retracts (Eckert 2004). Much of the research surrounding the California Shift focuses on only a subset of these features. The only investigation (before the current volume) that considers nearly all of them was Hinton et al. (1987). Their study was based on 22 participants from different areas of California, a majority of whom were middle-class, non-Hispanic European Americans ('Anglos') from the San Francisco Bay Area. The present paper represents a follow-up to their findings for the front lax vowels. We focus on 22 speakers from a single neighborhood in San Francisco, with equal numbers of Chinese Americans and European Americans. Gender and ethnicity have both been shown to be significant predictors of the California Shift, across the state of California and within San Francisco specifically.

Figure 1: San Francisco, California, in its regional context

Previous work outside of San Francisco has found evidence of the California Shift in both Northern and Southern Californian communities. The back vowel system, especially the fronting of BOOT, has so far garnered the most attention. The fronting of both BOOT and BOAT was documented in California by Hinton et al. (1987). Fought (1999) documented fine social conditioning of BOOT fronting based on a sample of 32 Mexican American young adults in Los Angeles, with the most fronted variants being produced by non-gang-affiliated women. BOOT and BOAT fronting is also reported in a study of one Vietnamese American gay man from Orange County (Podesva 2011). In the speech of 130 Californians from Redding, younger and country oriented residents have fronter variants of BOAT (Podesva et al. to appear). In all cases, the fronting of these vowels is inhibited by a following /l/ and promoted by a preceding coronal consonant (e.g., Hall-Lew 2011, Podesva et al. to appear). Podesva et al. (to appear) suggest that the fronting of BOAT following coronals preceded BOAT fronting in other environments.

The same speaker in Podesva's (2011) study also showed evidence of the BAT 'nasal split', a feature documented phonetically for the speech of 20 ethnically diverse preadolescents in Northern California (Eckert 2008). In Eckert's study, girls with the most local social capital had the greatest amount of pre-nasal BAT raising and pre-oral BAT retraction, but only in the social context where those features indexed desirable social qualities. Podesva et al. (to appear) find that younger country-oriented Redding

residents have the most raised pre-nasal BAT. There is no similar effect found for pre-oral BAT retraction, which is backer for younger speakers overall.

The lowering of the BIT and BET vowels has received relatively less attention before the present volume. An investigation of 13 speakers from a range of Californian locations provides some evidence for the lowering of BIT, BET, and BAT (Kennedy and Grama 2012). They found that women were leading men in these changes in progress, but their sample was mostly European American and they did not test for any effects of ethnic difference.

Features of the California Shift have been attested in San Francisco English. The fronting of BOOT and BOAT is the clearest result (Hall-Lew 2009, 2011), with apparent time correlations for BOOT after non-coronal segments and for BOAT in all conditions; BOOT after coronals is the furthest front but is not correlated with speaker year-of-birth, and thus may have gone to completion (Hall-Lew 2011). Women lead men in the fronting of BOAT but not in the fronting of BOOT. The apparent time correlation for BOOT after non-coronals is particularly robust among Chinese American women and not so among European American women; ethnic differences among men are less marked.

Despite findings that suggest that San Francisco does not exhibit the BOT/BOUGHT merger (Labov et al. 2006), other studies have found evidence of vowel coalescence in midpoint f1/f2 space, correlating with speaker year-of-birth (Moonwomon 1991; Hall-Lew 2009). This shift appears to be realized by a fronting and lowering of BOUGHT in apparent time, with no apparent time change in the quality of the BOT vowel (Hall-Lew 2013); acoustically, this may differentiate the change from that occurring in the central valley in California, where the merger results from raising of BOT (D'Onofrio et al. current volume) or elsewhere in California, where the merger has been described as resulting from a retraction of BOT (Eckert 2004). In San Francisco, there is no difference between men and women with respect to low back vowel production, but the change in apparent time is much stronger, and the extent of acoustic coalescence greater, among the Chinese Americans than among the European Americans (Hall-Lew 2013). This ethnic difference may go part of the way to explaining why the results in Hall-Lew (2013) differ from the results obtained in the Atlas of North American English (Labov et al. 2006), which only included (non-Hispanic) European Americans in the San Francisco speaker sample.

Little is known about the status of San Francisco's front vowels. A preliminary investigation of the front lax vowels in San Francisco using word list and reading passages demonstrate that certain front lax vowels may be participating in the California Shift (Hall-Lew et al. to appear). The current paper provides a more in-depth examination of the front lax vowels in San Francisco using interview data from the same participants. Furthermore, other possible conditioning environments are investigated to determine the relationship of San Francisco English to other varieties in the Western US. Specifically, we take a first look at the pre-/g/ environment, which is a conditioning environment for BET and BAT raising in Pacific Northwest varieties (Wassink current volume, Cardoso under review).

1.2 Pre-velar Raising

Pre-velar raising (or 'tensing') refers to a phenomenon found in many varieties in the United States and Canada (Labov et al. 2006), whereby the front lax vowels BAT and BET are raised before voiced velar consonants (BAG and BEG respectively). This process is reported to affect BAG in a wide range of locations across North America,

including Wisconsin (see, for example, Bauer & Parker 2008 and Benson 2011), Washington state (Reed 1952, Labov et al. 2006), Oregon (Conn 2000 and Becker et al. current volume), Michigan (Roeder 2009) and across Canada (Labov et al. 2006 and Boberg 2008). However, the co-occurrence of BAG and BEG raising is much more geographically constrained. It has been reported in the Atlantic States (Kurath and McDavid 1961), Oregon (Becker et al. current volume), the Washington state (Wassink et al. 2009, Freeman 2013, Wassink current volume) and British Columbia in Canada (Gregg 1957, Cardoso under review). These dialects have a raised variant of BAG and BEG in words such as *bag* and *egg*; the resultant productions are closer to [ɛ] for BAG and [e] for BEG.

To our knowledge, the only report of a variety which exhibits BEG raising without BAG raising is in Nevada (Fridland et al. in progress). BEG raising alone was initially thought to occur in British Columbia, as earlier descriptions of this variety only make mention of BEG raising without reporting BAG raising (Gregg 1957), but further investigation provide evidence for the presence of both (Cardoso under review).

Recent investigations of raising in Washington state find that BEG, and potentially BAG, may be merging with BAIT (Wassink et al. 2009, Freeman 2013, Wassink 2015, Wassink current volume). This is not reported for the other nearby locations with pre-velar raising – British Columbia in Canada (Cardoso under review) and Oregon (Becker et al. current volume). Wassink et al. (2009) find that gender is a factor in the extent to which these pre-velar front vowels merge; males tend to have a three-way merger between BEG and BAG and BAIT (Wassink et al. 2009, Freeman 2013), whereas females tend to merge BEG and BAIT. Freeman (2013) and Wassink (2015) report that raising of BAG and BEG is evident in speakers of all ages, but that older speakers produce a raised midpoint while younger speakers producing a relatively more diphthongal vowel. Oregon also shows evidence of gender and age differences in raising of BEG and BAG (Becker et al. current volume), whereby older speakers are found to produce the most raising for both vowels, as well as the most fronting of BAG. They also find that women are leading in fronting of BEG.

This evidence of pre-velar raising in the Englishes north of California has emerged relatively recently. Given that there has been no investigation of pre-velar raising in Northern California, and that there is little information about the front lax vowels in San Francisco, a thorough examination of those vowels should include analysis of the pre-/g/ environment. By investigating whether San Francisco participates in pre-velar raising, it is possible to gain a better understanding of the outer limits of pre-velar raising and the relationship between San Francisco and the varieties to the north of the city. The pattern in Washington state and British Columbia specifically predicts that BEG and BAG vowels should front and raise for all speakers and diphthongize for younger speakers, whereas the pattern in Oregon suggests that only the fronting of BEG is a change in progress. If there is a pre-velar pattern in San Francisco, we might expect it to pattern more like Oregon than Washington state.

In contrast to pre-velar raising, the California Shift specifically predicts that BET and BAT before non-nasal segments, like /g/, should retract and lower. Other evidence also predicts that BIT should similarly retract and lower, except when preceding velar nasals (Eckert 2004). The present analysis of the front lax vowels in San Francisco, therefore, also allows for further comparison of the similarities and differences between San Francisco English and other Californian Englishes. Will it

pattern with the rest of California, as in BOOT and BOAT, or will it appear somewhat distinct, as in the BOT/BOUGHT distinction?

2 Methodology

The speaker sample is equally stratified across age, binary gender, and ethnic heritage. A balanced sample is useful in distinguishing between purely linguistic features and those features that are influenced by sociolinguistic conditioning. Vowels are taken from interview speech to augment the results of the read speech data that was analyzed in Hall-Lew et al. (to appear). A detailed statistical analysis on the results using linear mixed-effects models is performed on single first and second formant measurements for each vowel class.

2.1 Participants

The speaker sample consists of 22 native San Franciscans born between 1932 and 1991 and interviewed by the second author in 2008-2009 (Table 1). All speakers in the current sample were interviewed individually in their homes or places of work, and interviews ranged in length from 37 to 138 minutes. Analysis of these speakers' read speech (word lists and reading passages) has been conducted in a preliminary investigation of the front vowel system (Hall-Lew et al. to appear), and the current paper focuses on unstructured interview speech.

Previous work on San Francisco English indicates that the back vowel features of the California Vowel Shift are progressing in apparent time at a faster rate among women than among men, and at a faster rate among Asian- or Chinese Americans than among European Americans (Hall-Lew 2009, 2011, 2013). While previous samples have included some Asian Americans of mixed, non-Chinese, or specifically non-Cantonese heritage, the current sample of Chinese San Franciscans includes only native English speakers of Cantonese heritage, to better control for variation in ethnic identity (see also Wong & Hall-Lew 2014). The term 'White' is used here to refer to all speakers who identify with this label, 'Anglo', or 'Caucasian'. All speakers are English dominant, and some are variably bilingual (in both ethnic groups). Level of bilingualism has not been a predictor of English vowel variation in previous related studies (Hall-Lew 2009), and so was not considered as a factor here. Because of the nature of the interview sample, there is one fewer man than woman in each speaker subsample; this is particularly unfortunate for the group of Chinese men, who have no representation in their oldest cohort. Previous work (e.g., Hall-Lew 2013) has filled this gap with a non-native English speaker who we decided to exclude from the current study.

Table 1: Speaker sample and demographics

Ethnicity	*N*	Gender	*N*	Age Range	YOB
Chinese	12	F	6	Oldest	1932
				Youngest	1991
		M	5	Oldest	1962
				Youngest	1991
White	12	F	6	Oldest	1942
				Youngest	1991
		M	5	Oldest	1941

2.2 Measurement, Normalization, and Modeling

In contrast to all previous work on sound change in San Francisco English, which relied on a much smaller hand-aligned dataset (except for Hall-Lew et al. to appear), the current dataset has been automatically phone-aligned and all vowel measurements have been automatically extracted using FAVE (Rosenfelder et al. 2014). In order to provide results consistent with the read speech results (Hall-Lew et al. to appear), the current analysis uses the single-point FAVE defaults for f1 and f2. These measurements are all taken at the 1/3 of the vowel duration for those lexical sets under analysis here: BIT, BET, and BAT.

The initial dataset included all possible vowel classes, but was trimmed for consistency. All tokens immediately preceded by (N=12,717) or followed by (N=9,340) a noise were deleted, all tokens without primary lexical stress (N=10,529) were deleted, the word *yeah* (N=23) was also deleted, and measurement errors (N=1118) were deleted. The final dataset contains 79,343 vowel tokens, 23,723 of which correspond to the three front lax vowels.

The front lax vowels are divided into a number of categories based on following phonological environment to directly compare predictions made by previous work on the California Shift and on pre-velar raising. Table 2 presents the revised lexical sets for the current study and the number of tokens in each. Previous research on the California Shift (Hinton et al. 1987, Hall-Lew et al. to appear) and on pre-velar raising (Baker et al. 2008, Cardoso under review) indicated that preceding environment may affect vowel productions. The preceding environment is included in the statistical analysis of the target vowels, but is not taken into account in the categories in Table 2.

Evidence from previous research on pre-velar raising suggests that BET and BAT are raised to the same extent or more before /ŋ/ due to a further lowering of the f1 induced by velum lowering (Baker et al. 2008, Cardoso under review). The current investigation only has one token of BET before the velar nasal. Therefore, it is not possible to comment on the status of BET before velar nasals at this time and no subcategory for this vowel with a following /ŋ/ is included in the analysis.

Table 2: Vowel subcategories, descriptions, and number of tokens each.

Vowel	Category	Description	No. of Tokens
BIT	BIT2	all BIT except before nasals & /g/	5157
	BIN	BIT before /m/ & /n/	1080
	BING	BIT before /ŋ/	607
	BIG	BIT before /g/	172

BET	BET2	all BET except before nasals & /g/	6052
	BEN	BET before /m/ & /n/	2121
	BEG	BET before /g/	15
BAT	BAT2	all BAT except before nasals & /g/	6031
	BAN	BAT before /m/ & /n/	2286
	BANG	BAT before /ŋ/	180
	BAG	BAT before /g/	15

Pre-velar raising has mostly been investigated in word list and reading passage speech or experimental perception tasks, such as semantic differentials (Wassink 2015, Wassink et al. 2009, Becker et al. current volume, Cardoso under review), but has generally not been investigated in interview speech. The token numbers in Table 2 indicate why this is so; there are vastly fewer naturally occurring instances of BEG and BAG than there are for any of the other lexical sets. Across all 22 speakers, we find only 15 tokens of BEG and BAG, compared to 253 tokens of BET before /k/ and 801 tokens of BAT before /k/. In fact, thirteen of the speakers in the current sample have no instances of BAG, eleven of the speakers have no instances of BEG, and two of the speakers have no instance of BIG. Because pre-velar environments were not included in the reading passage and word list materials during the 2008-2009 fieldwork, we have to rely on these interview speech occurrences for the analysis. Therefore, only a preliminary investigation into pre-velar raising in San Francisco English will be possible. On the other hand, the sample does provide ample tokens to present a detailed account of San Francisco's relationship to the more general front lax vowel features of the California Shift.

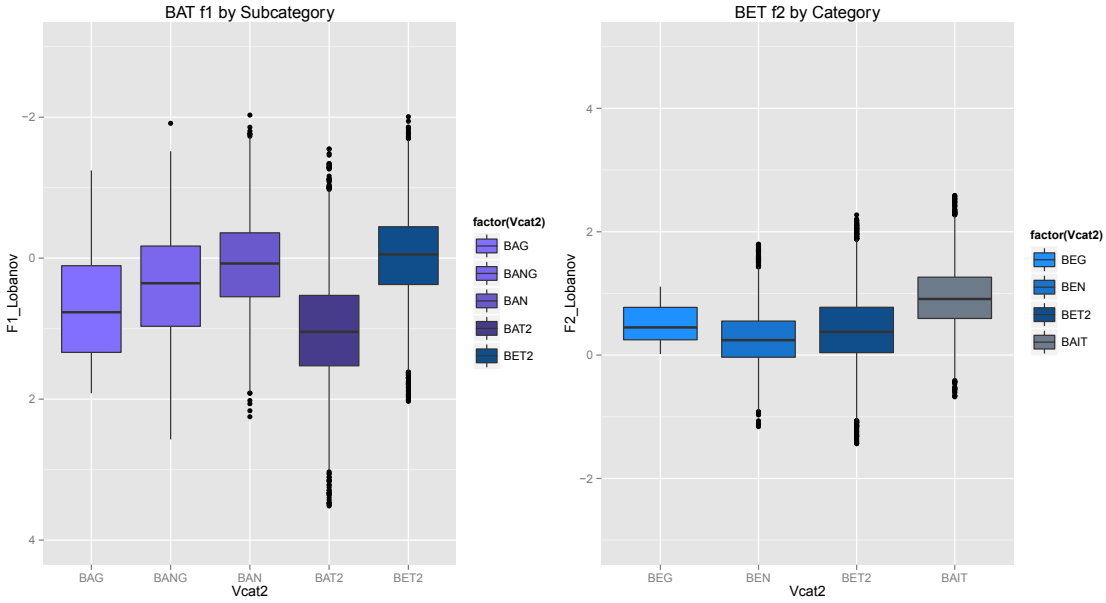
FAVE measurements for the initial dataset were normalized in R using the Lobanov method in the `vowels.R` package (Kendall and Thomas 2009-2014). A statistical analysis of the data was performed using linear mixed-effects models, built using the `step()` function in the `lmerTest` package (Kuznetsova et al. 2014). The dependent variables for all models were normalized f1 and f2 measurements, with each vowel (indicated as BIT, BET and BAT in the following findings), vowel subcategory (indicated as lexical sets provided in Table 2) and formant modeled separately. The linguistic constraints included in each initial model are PRECEDING and FOLLOWING phonological environment, each coded as a single factor encompassing both manner and place features, where relevant. The models for each overall vowel (BIT, BET, BAT) have following oral velars as a single factor encompassing voice, as well as place and manner. The social constraints, included both as fixed main effects and as interaction effects, were YOB (speaker year-of-birth), SEX (male, female), and ETHNICITY (Chinese, White). Random effects included SPEAKER and WORD. In the models involving the BET vowel the following phonological environment *nasal_velar* was removed, as there was only one token of BET before /ŋ/ and the models could not converge with this token included. Furthermore, BEG and BAG were not modeled independently to BET and BAT due to the small number of tokens.

3 Results

The linguistic and social factors that are significant predictors of the models differ for each of the vowels and vowel subcategories (see Table 2), in ways similar to those seen in Hall-Lew et al. (to appear) for the reading passage and word list data. Overall, preceding and following environments are significantly correlated with normalized f1

and f2 measurements for all three front lax vowels; all indicate known phonetic coarticulatory effects.

Figure 2: Comparison of the subcategories for BET and BAT



Results from linear mixed-effects models indicate that the pre-/g/ environment is a conditioning factor for BET f2 and BAT f1 (Figure 1). BEG is fronter than BET2 tokens, BAG is higher than BAT2. However, BAG is not raised to the same extent as BANG or BAN. Figure 2 includes BAIT for comparison of the BET results, and BET2 for comparison with BAT. Note that these effects do not directly correspond to descriptions for other varieties with pre-velar raising. Statistical analysis of the pre-/g/ environment in these vowels, BEG or BAG, are not available, but graphical representations suggest that BEG is not fronted to the extent of BAIT and BAG is not raised to the extent of BET.

BIG, which is generally not included in discussions of pre-velar raising, does not show signs of raising or fronting relative to BIT. The results for BIT show that BIT2, BIN, and BIG are all lower and retracted and that BING productions are raised. These findings correspond well to descriptions of the California Shift (Kennedy and Grama 2012, Eckert 2008). Gender is a predictor of the respective models for BING f1, with women favoring the more advanced variant. Year-of-birth is not a predictor for any of the BIT models, suggesting that lowering and retraction of BIT2, BIN, and BIG and raising of BING is not a change in progress. Rather there is a phonologically conditioned split in BIT (with gender effects for some variable productions), where the criteria for the split are different from those for BAT (i.e., the trigger for raising is a following velar nasal, not just any nasal).

BET is higher and fronter when preceded by an oral velar onset, in line with Hinton et al. (1987) and Hall-Lew et al. (to appear). Similar to Hall-Lew et al. (to appear), BET is also higher and fronter when preceded by an apical nasal onset, but does not raise (or front) before nasals. In fact, BEN and BET2 produce almost identical results in the statistical analysis; there is no BET nasal split. As a result of the *merry-Mary-marry* merger (see Labov et al. 2006), which San Francisco appears to participate in, BET2 tokens are higher before liquids than other environments. Note

that 85% (N=2920) of the BET2 tokens before liquids are BET followed by /r/, such as *there*, rather than BET followed by /l/.

BAT2 productions are lowest and most retracted both when preceded by liquids as well as when followed by liquids, which in the case of BAT2 are mostly /l/ (70% /l/, N=107 preceding; 90% /l/, N=123 following). There is also substantial lowering of BAT before /k/, which suggests that the raising of BAG is not purely due to phonetic co-articulation. Overall, BAT is found to be lowering and retracting in accordance with the California Shift, except before oral voiced velars (BAG). We also find evidence of the nasal split, where BAN is higher and fronter than all of the other BAT subcategories. This raising and fronting is most inhibited when the nasal in BAN is an /m/ or when the onset consonant is a liquid.

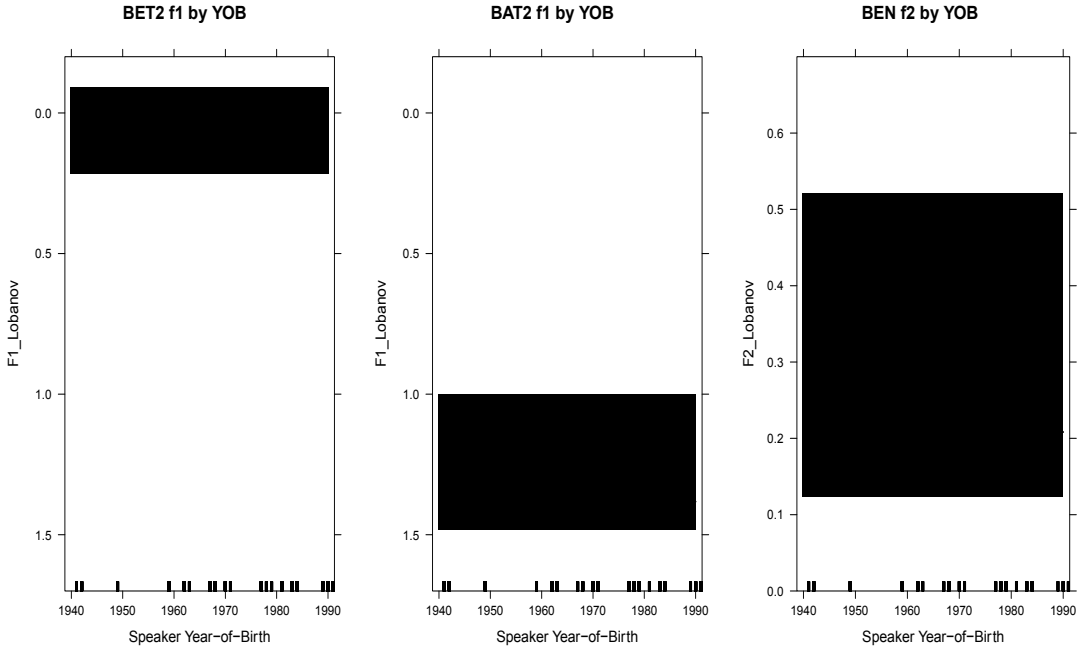
The three social constraints included in the current analysis (year-of-birth, binary gender, and ethnicity) are discussed below in turn.

3.1 Change in Apparent Time: Speaker Year-of-Birth

Speaker year-of-birth (YOB) is found to significantly correlate with f1 measurements of BET2, BAT2, and f2 measurements of BEN. In the preliminary study on the front vowels using read speech, BAT f2 and BAN f1 is also correlated with YOB (Hall-Lew et al. to appear), which is not born out of the current study. Figure 3 plots YOB from 1932 to 1991 on the x-axis and normalized formant values on the y-axes, reversed for BET2, BAT2 (so a lower y-value indicates a lower vowel), and standard for BEN f2 (where a lower y-value indicates a retracted vowel). All of the correlations shown achieve statistical significance in model comparisons.

The current results in combination with the read speech results provide substantial evidence that BET lowering and the BAT nasal split are both advancing in apparent time in San Francisco English, in line with other Californian varieties.

Figure 3: Significant Fixed Effects of Year-of-Birth



3.2 Change in Apparent Time: Speaker Gender

Speaker gender is significantly correlated with BING f1, and f2 measurements of BAT2 (Figure 4) and an interaction between year-of-birth and gender is a significant predictor in the model of BANG f1 (Figure 5). In all cases, the more advanced or non-standard productions are attributable to the female speakers, which evidences the well-documented phenomenon of female-led changes in progress that has been found for other aspects of the California Shift (in San Francisco and elsewhere) and in sound change studies more generally. Furthermore, these results support the finding for read speech (Hall-Lew et al. to appear) that BAT retraction is a change in progress being led by females. Figure 3 shows the results of the linear-mixed effects model for the predictor GENDER in BING f1, and f2 of BAT2. Speaker gender is plotted on the x-axis and the dependent variable along the y-axis. As before, the y-axis for the BING f1 plot has been reversed so that values that are lower represent lower vowel productions and the lower values on the y-axis for BAT2 f2 represent retracted variants.

BANG f1 is the only vowel subcategory to show a significant interaction of gender and year-of-birth. As can be seen in Figure 5, male speakers are lagging behind with a robust apparent time correlation towards the high stable female norm.

Figure 4: Significant Fixed Effects of Speaker Gender

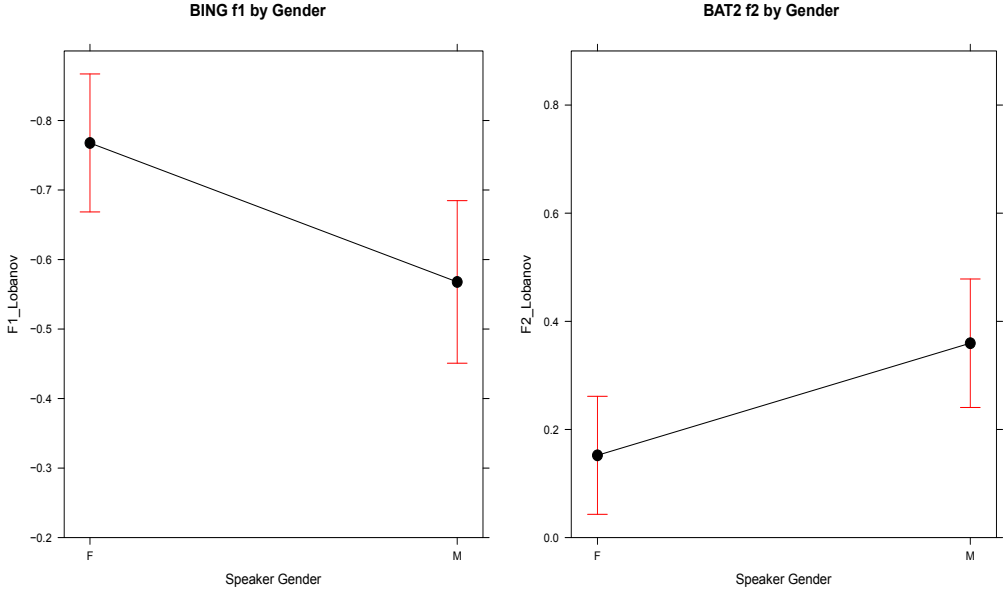
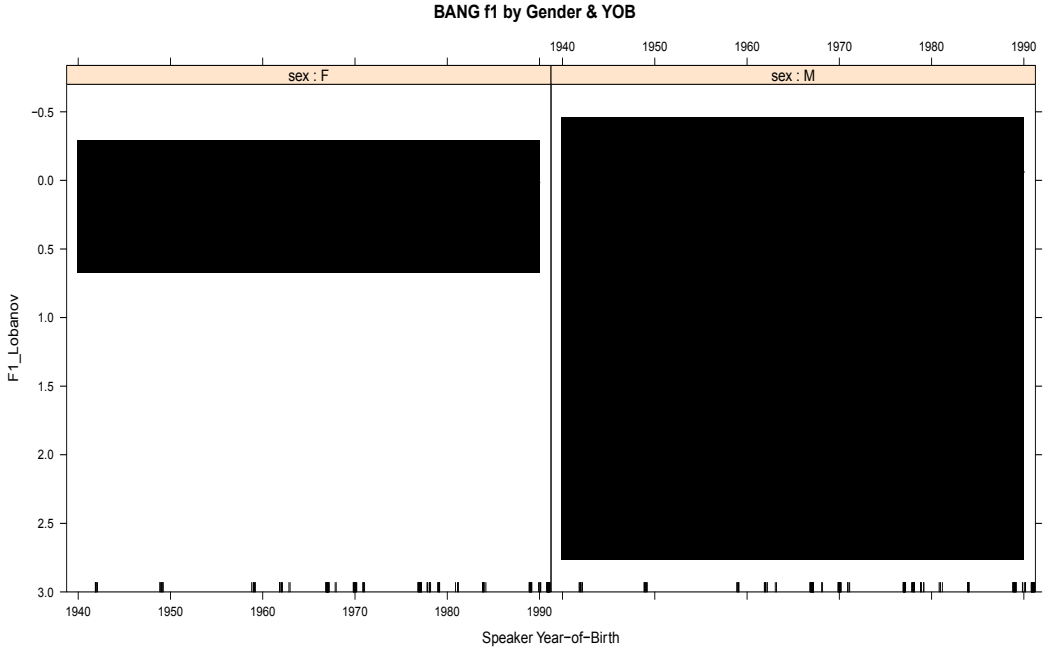


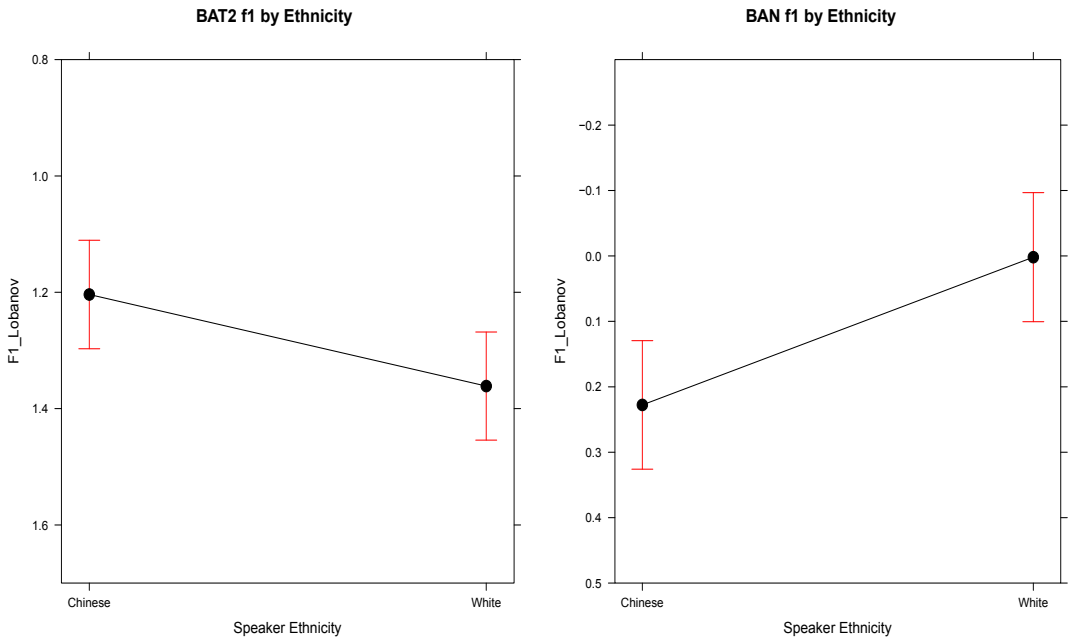
Figure 5: Significant Interaction between Year-of-Birth and Speaker Gender



3.3 Change in Apparent Time: Speaker Ethnicity

Previous research on San Francisco English provides evidence of change in progress being led by Chinese Americans: the apparent time correlation is more robust, and the most advanced variants are also acoustically more advanced than in the European American cohort (Hall-Lew 2009, 2011, 2013). In this study, BAT2 and BAN f1 values are significantly correlated with ethnicity (Figure 6; note that y-axis values are not matched between vowels). Chinese American speakers show lower productions of BAN and higher productions of BAT2 than European American (White) speakers; in other words, less of a nasal split. Thus, while the apparent time correlations have appeared stronger among Chinese Americans for some of the back vowel changes (Hall-Lew 2009, 2013), in BAT we see the opposite pattern (see also Eckert 2008). Hall-Lew et al. (to appear) found that variation was not significantly correlated with ethnicity in read speech, however we see here that in interview speech an ethnic difference obtains.

Figure 6: Significant Fixed Effects of Speaker Ethnicity



3.4 Summary

A summary of the social factors that are correlated with the vowel subcategories is presented in Table 3.

Table 3: Summary of Significant Social Effects

Social Factor	Linguistic Variable	Direction of Effect
YOB	BET2 f1	young lowering
	BAT2 f1	young lowering
	BEN f2	young retracting
GENDER	BING f1	females raised
	BAT2 f2	females retracted
ETHNICITY	BAN f1	whites raising
YOB & ETHNICITY	BAT2 f1	young & whites lowering
YOB * GENDER	BANG f1	females stable and high, young males raising

4 Discussion

4.1 San Francisco and Pre-velar Raising

The preliminary investigation of pre-/g/ environments suggests that aspects of pre-velar raising occur in San Francisco English, though not exactly in the same ways as in Oregon, Washington state, and British Columbia. Here, all three front lax vowels were investigated in the pre-/g/ environment. Studies of pre-velar raising have generally not included BIT in the analysis, and in the present study the pre-velar subclass, BIG, is found not to participate in raising. However, similar to other studies, both BAT and BET are conditioned by the following /g/. While BEG is fronted compared to BET2 and BEN, BAG'S raised position relative to BAT2 is not so dramatic as the raising of BANG and BAN. Fronting is the main distinguishing characteristic of

BEG, similar to the findings for Oregon (Becker et al. current volume), while raising mainly differentiates BAG from BAT2 (excluding BAN and BANG).

These findings may indicate that San Francisco English is participating in aspects of pre-velar raising found in the Pacific Northwest. If this is the case, then the outer limits of pre-velar raising might be within northern California, which is much further south than has generally been assumed. Alternatively, the results may rather indicate that San Francisco is participating in the California Shift, but that the shift of BET and BAT is inhibited in pre-/g/ environments. In this hypothesis, BET and BAT are lowering and retracting in accordance with the California Shift, but BAG and BEG are inhibited, potentially as a result of coarticulatory pressures.

Coarticulatory pressure have been used as an explanation for pre-velar raising in some varieties (see, for example, Baker et al. 2008), such that raising results from the lowering of f1 and raising of f2 characteristic of vowels followed by /g/. There is also evidence that the velar pinch effect, which affects both pre-/k/ and pre-/g/ contexts, differs in duration for pre-/k/ contexts versus pre-/g/ contexts. The pre-/g/ context has a longer velar pinch resulting in a diphthongal variant (see Freeman 2013, Wassink 2015, and Cardoso under review). In contrast, the velar pinch in pre-/k/ vowels is much shorter (Cardoso under review). It is possible that this mismatch in velar pinch duration might help account for why pre-velar raising, or California Shift inhibition, appears to only affect those vowel before /g/ and not those before /k/.

A larger sample of tokens across all speakers would be required to test these two hypotheses, as well as any sociolinguistic factors that may be affecting pre-velar raising. Therefore, the preliminary investigation can only confirm that for a subset of speakers, BEG tokens are further front compared to BET in other environments and BAG tokens are raised compared to BAT before other non-nasal consonants.

4.2 San Francisco and the California Shift

Regardless of the status of the pre-/g/ environments, the overall results suggest that San Francisco English is participating in those front vowel changes that have been most robustly documented as part of the California Shift: the lowering and retraction of BET and the BAT nasal split (Eckert 2004, 2008; Podesva 2011; Kennedy & Grama 2012). This pairs well with previously reported results of San Francisco's participation in back vowel fronting (Hall-Lew 2009, 2011), as well as the evidence that the same speakers are gradually merging BOT and BOUGHT in apparent time (Hall-Lew 2009, 2013). Taken together, the present paper presented further evidence to argue against a characterization of contemporary San Francisco English as a dialect isolate (cf., Labov et al. 2006).

The specific results for BET show that the vowel (including BEN and BEG) is retracting in apparent time; additionally, BEN is itself retracting, and BET2 (excluding both BEN and BEG) is lowering. The specific results for BAT show that the lexical subset that excludes pre-velars and pre-nasals, BAT2, is lowering in apparent time. Since we do not see the pre-nasal context (BAN) raising in apparent time, the data only present evidence for half of a BAT nasal split process. We would also expect to see significant correlations with year-of-birth on the f2 dimension, which did not obtain here. This is particularly perplexing because the analysis of read speech (Hall-Lew et al. to appear) does show an apparent time correlation for BAT f2 (and, actually, not for BAT f1). It could be that these incongruent results reflect a simple problem of too little data, and future work will endeavor to test for this possibility.

Two dimensions that do not correlate with speaker year-of-birth do correlate with speaker gender: BING is higher among females than males; and BAT2 is retracted among females than males.

Overall, these results and those of Hall-Lew et al. (to appear) provide evidence that San Francisco English is participating in changes in apparent time similar to other Californian Englishes, distinguishing it from the Pacific Northwest (Wassink 2015). At the same time, the relatively more raised productions of BEG and BAG potentially place San Francisco also within the northwest US varieties, although more data are needed to test for apparent time correlations for these rarely-occurring lexical items.

One aspect of the California Shift that has not been previously reported is found here for the lexical subset BANG (BAT before velar nasals), where BANG is found to be raising in apparent time, and differentiated by speaker gender. For the female speakers this appears to be a completed change, as the vowel is uniformly high and height does not co-vary with speaker year-of-birth. For the male speakers we see a robust apparent time correlation, with older males showing lower productions of BANG and younger males moving toward the stable female production pattern.

Lastly, while ethnicity was not found to correlate with any of the read speech results, here it is found to be a significant predictor for the lowering of BAT2 and raising of BAN. This results in a difference between the nasal split for Chinese American and European American speakers, where the change is more advanced for the latter than the former. This is the first time a California Shift change in San Francisco English has been found to be less robust in the Chinese American subsample, in contrast to changes where the apparent time change was stronger for the Chinese Americans (e.g., low back merger; Hall-Lew 2013) or where there was no ethnic difference (e.g., BOOT fronting; Hall-Lew 2011). However, it does pair well with findings such as those of Eckert (2008), where in certain Northern Californian contexts, the BAT nasal split was argued to index social meanings associated with White or otherwise non-Chicano social persona. The present finding therefore presents an update to previous claims about ethnicity and sound change in San Francisco: while the majority status of Chinese Americans in the local community might predict the leading of local sound changes by members of that ethnic group, this might not be the case for any instances of sound changes that index ethnic persona that are at odds with Chinese American identity. A full investigation of these issues is beyond the scope of the present study and is left for future work.

5 Conclusions

This paper presents an analysis of the front lax vowels of San Francisco English based on unscripted, spontaneous interview speech from 22 men and women of various ages and ethnic backgrounds. The results suggest that San Francisco English is participating in the California Shift with respect to the lowering and retraction of the BET vowel and the BAT nasal split. These changes are socially conditioned, such that women are leading in the retraction changes, and European Americans are leading Chinese Americans in both BAT retraction and the raising of BAN. The results also show preliminary evidence for a kind of pre-velar raising for both vowels, although this might be better described as an inhibition of retraction and lowering rather than a raising movement, per se. We also find the first evidence for a robust, gender-stratified change in the raising of BANG, specifically. Overall, San Francisco English seems to exhibit precisely the Northern Californian vowel system one would expect.

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7 Appendix: Mixed Effects Models: Subset of significant effects

Following Environment

Model	Level	Estimate	Standard Error	t-Value	Stat. Sig.
BAT f1	(Intercept)	1.01008	0.15824	6.383	***
	nasal_apical	-0.65432	0.13823	-4.734	***
	nasal_labial	-0.61948	0.15126	-4.095	***
	nasal_velar	-0.37582	0.16816	-2.235	*
	liquid	0.05776	0.16153	0.358	
	oral_apical	0.48567	0.13979	3.474	***
	oral_labial	0.63088	0.14408	4.379	***
	palatal	0.31340	0.15788	1.985	*
	oral_vd_velar	-0.11471	0.23593	-0.486	
	oral_vl_velar	0.64851	0.14476	4.480	***
BET f2	(Intercept)	-0.26366	0.21659	-1.217	
	nasal_apical	0.47170	0.21276	2.217	*
	nasal_labial	0.35435	0.22329	1.587	
	liquid	0.48368	0.21239	2.277	*
	oral_apical	0.41145	0.21196	1.941	
	oral_labial	0.34814	0.21324	1.633	
	palatal	0.38520	0.22118	1.742	
	oral_vd_velar	0.62452	0.26029	2.399	*
	oral_vl_velar	0.49593	0.21597	2.296	*

Social Factors

Model	Level	Estimate	Standard Error	t-Value	Stat. Sig.
BET2 f1	(Intercept)	-6.100e+00	2.111e+00	-2.890	**
	yob	3.107e-03	1.071e-03	2.902	**
BEN f2	(Intercept)	7.876e+00	3.303e+00	2.385	*
	yob	-3.928e-03	1.675e-03	-2.345	*

BING f1	(Intercept)	-0.76774	0.05054	-15.190	***
	gen_male	0.19997	0.07809	2.561	*
BAT2 f2	(Intercept)	-0.045178	0.085624	-0.528	
	gen_male	0.207316	0.077883	2.662	*
BAN f1	(Intercept)	0.40185	0.10288	3.906	***
	ethnic_white	-0.22584	0.07100	-3.181	**
BAT2 f1	(Intercept)	-13.058573	3.877716	-3.131	**
	yob	0.006986	0.001962	3.373	**
	ethnic_white	0.164214	0.054565	3.271	**
BANG f1	(Intercept)	10.234874	11.260901	0.909	
	yob*gen_male	-0.033075	0.013601	-2.432	*